

REMARKS

Claims 1-7 and 18-19 are pending in this application. No claim amendments are made in this paper. Applicant respectfully submits that the pending claims are allowable for these additional reasons.

I. The Rejection Under 35 U.S.C. §103(a) Should Be Withdrawn.

On page 2 of the Office Action, the Examiner has maintained the rejection of claims 1-7, 18, and 19 under 35 U.S.C. §103(a) as being allegedly unpatentable over Muller *et al.*, U.S. Patent No. 6,020,358 (“Muller”) in view of Tobinick, U.S. Patent No. 6,428,787 (“Tobinick”), and D’Amato, U.S. Patent No. 6,235,756 (“D’Amato”). Applicant respectfully traverses this rejection.

On August 5, 2008, Applicant submitted a Supplemental Response, wherein evidence of unexpected results sufficient to rebut the alleged *prima facie* case of obviousness was presented in a declaration. In the Advisory Action that followed, the Examiner noted that the declaration was not entered. Advisory Action, page 1. In other words, it appears that the evidence may not have been considered by the Examiner because it is alleged in the Advisory Action that the “affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented.” Advisory Action, page 1.

In this regard, Applicant submits herewith, concurrently with the filing of a Request for Continued Examination, evidence of unexpected results sufficient to rebut the alleged *prima facie* case of obviousness. Thus, the evidence is properly submitted for entry into the record of the instant application and must be considered by the Examiner.

As well settled, even if a *prima facie* case of obviousness is established, the Examiner is required to consider all rebuttal evidence submitted by an applicant. *See In re Sullivan*, 498 F.3d 1345 (Fed. Cir. 2007); *see also* MPEP §2145. This requirement remains unchanged following the decision in *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727 (2007), as the Federal Circuit has made clear in *In re Sullivan*. 498 F.3d at 1351. As the Court explained, “[w]hen a patent applicant puts forth rebuttal evidence, the Board must consider that

evidence.” *Id.* Such rebuttal evidence includes “evidence of unexpected results.” *Id.*, citing *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1369 (Fed. Cir. 2007).

Attached hereto for the Examiner’s consideration is a declaration from Peter H. Schafer, Ph.D. (“Declaration”)¹, which describes experiments that were performed to evaluate the efficacy of cyclopropyl-N-{2-[(1S)-1-(3-ethoxy-4-methoxyphenyl)-2-(methylsulfonyl)ethyl]-3-oxoisindoline-4-yl}carboxamide (“the instant compound”) in the treatment of macular degeneration.

As the Examiner will see, the oral administration of the instant compound to mice unexpectedly resulted in remarkably higher inhibition of laser-induced choroidal neovascularization compared to the intravitreal injection of Lucentis, which is a FDA-approved drug for the treatment of wet age-related macular degeneration.² *See, e.g.*, Declaration, paragraph 13 and Figure 1. Further, the oral administration of the instant compound to rats unexpectedly resulted in similar inhibition of laser-induced choroidal neovascularization compared to intravitreal injection of Lucentis.³ *See, e.g.*, Declaration, paragraph 14 and Figure 2.

In view of the above, Applicant has provided sufficient unexpected results that rebut any alleged *prima facie* case of obviousness. Thus, Applicant respectfully requests that the rejection under 35 U.S.C. §103(a) be withdrawn.⁴

II. Conclusion

A fee of \$1,110.00 is believed to be due for an extension of time for three months, which will also be paid via EFS Web. Further, a fee of \$810.00 is believed due for the Request for Continued Examination which will also be paid via EFS Web. If any additional

¹ Attached hereto as **Exhibit I**.

² Administration of the instant compound at 5 mg/kg BID resulted in a 69% reduction in the neovascular area, and the administration at 15 mg/kg resulted in 73% reduction in the neovascular area ($P < 0.002$). The inhibition resulting from the intravitreal injection of Lucentis was 36% ($P = 0.0913$ under Dunnett’s Method; $P = 0.0423$ under Student’s t-test).

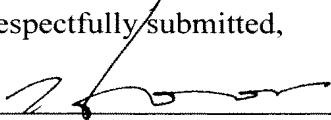
³ Administration of the instant compound at 10 mg/kg BID resulted in a 61% reduction in the neovascular area, and administration at 25 mg/kg BID resulted in 65% reduction ($P < 0.0001$). The inhibition resulting from the intravitreal injection of Lucentis was 62% ($P < 0.0001$).

⁴ Even in the absence of unexpected results, the rejection under 35 U.S.C. §103 can not stand because the Examiner has not established a *prima facie* case of obviousness, as discussed in Applicant’s Response dated July 15, 2008, the entirety of which is incorporated herein by reference.

fees are due for the submission of this paper or to avoid abandonment of this application,
please charge them to Deposit Account No. 50-3013.

Respectfully submitted,

Date: October 15, 2008



Hoon Choi Ltd. Reg. No.: L0209
for: Anthony M. Insogna Reg. No.: 35,203
JONES DAY
12265 El Camino Real, Suite 200
San Diego, CA 92130
(858) 314-1200

Exhibit 1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	Zeldis	Confirmation No.:	1866
Serial No.:	10/699,110	Art Unit:	1612
Filed:	October 30, 2003	Examiner:	Fay, Zohreh A.
For:	METHODS FOR THE TREATMENT AND MANAGEMENT OF MACULAR DEGENERATION USING CYCLOPROPYL-N-{2-[(1S)-1-(3- ETHOXY-4-METHOXYPHENYL)-2- (METHYLSULFONYL)ETHYL]-3- OXOISOINDOLINE-4- YL}CARBOXAMIDE	Docket No:	9516-083-999
		CAM:	501872-999082

DECLARATION BY PETER H. SCHAFER, PH.D. UNDER 37 C.F.R. § 1.132

Mail Stop AF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, PETER H. SCHAFER, Ph.D., declare as follows:

1. I have personal knowledge of the matters contained herein, or know them by my review of U.S. Application No. 10/699,110 or my review of studies performed at the Vanderbilt University School of Medicine, Departments of Pathology and Ophthalmology.

I. Background

2. I received my Bachelor of Science degree in Biological Chemistry from the University of Chicago, Chicago, Illinois in 1991. I received my Ph.D. degree from the Department of Biochemistry, Molecular Biology, and Cell Biology at Northwestern University, Evanston, Illinois in 1996.

3. From 1996 to 1999, I was a post-doctoral researcher at The R.W. Johnson Pharmaceutical Research Institute in Raritan, New Jersey. From 1999 to present, I have been employed by Celgene Corporation, Summit, New Jersey, as a Research Scientist, a Senior

Research Scientist, a Group Leader, then as an Associate Director of Biology. Currently, I hold a position of the Director of Biology in the Department of Drug Discovery at Celgene Corporation.

4. I have published in peer-reviewed journals and made presentations at various academic conferences. I am also a named co-inventor of several patents and patent applications, including applications and patents owned by Celgene Corporation.

5. I am affiliated with the International Society for the Biological Treatment of Cancer, American Association for the Advancement of Science, and American Association of Immunologists. I have been serving as a reviewer for academic journals such as the Journal of Pharmacology and Experimental Therapeutics, European Journal of Hematology, and Leukemia and Lymphoma. My curriculum vitae is attached hereto as **Exhibit A**.

II. Evaluation of cyclopropyl-N-(2-[(1S)-1-(3-ethoxy-4-methoxyphenyl)-2-(methylsulfonyl)ethyl]-3-oxoisindoline-4-yl)carboxamide

6. On the basis of my review of U.S. Application No. 10/699,110, I understand that the pending claims in the present application recite, *inter alia*, methods of treating macular degeneration comprising administering cyclopropyl-N-(2-[(1S)-1-(3-ethoxy-4-methoxyphenyl)-2-(methylsulfonyl)ethyl]-3-oxoisindoline-4-yl)carboxamide ("the instant compound").

7. I understand that Celgene Corporation commissioned the Vanderbilt University School of Medicine, Departments of Pathology and Ophthalmology, to evaluate the efficacy of the instant compound in the inhibition of choroidal neovascularization and to compare any such efficacy to Lucentis[®], a FDA-approved drug for the treatment of wet age-related macular degeneration.

A. Protocol

8. I understand that the tests utilized the laser-induced rupture of Bruch's membrane choroidal neovascularization ("CNV") model. These tests were performed on both mice and rats. Specifically, the tests were performed on Brown Norway rats and C57BL/6J mice (males; 4-6 weeks of age).

9. I understand that laser-induced rupture of Bruch's membrane was used to generate CNV. The animals were anesthetized with xylazine hydrochloride (10 mg/kg) and ketamine (50 mg/kg), and the pupils were dilated with 1% tropicamide (Alcon Labs, Inc.; Fort Worth, TX). A hand-held cover slide was used as a contact lens, and an argon laser photocoagulator (532 nm) mounted on a slit-lamp (Coherent Novus Omni, Lumenis Inc.; Santa Clara, CA) was employed to create four burns centered around the optic nerve head in the retinal mid-periphery (50 μ m spot size, 0.1 sec duration, 360 mW) in the rats. For the mice, the procedures were similar with the exception that the laser energy was set to 260 mW. This procedure causes a bubble at the time of laser application to indicate rupture of Bruch's membrane. Burns not resulting in a bubble were not included in the study. Immediately after laser treatment, the rats and mice were divided into four groups for the administration of drugs.

10. I understand that the dosing regime for the mice was as follows: (1) oral administration of the instant compound at 5 mg/kg BID; (2) oral administration of the instant compound at 15 mg/kg BID; (3) oral administration of the vehicle BID; and (4) intravitreal administration of 2 μ L Lucentis® (10 mg/mL, positive control treatment) at 1, 3, and 7 days following laser treatment.

11. I understand that the dosing regime for the rats was as follows: (1) oral administration of the instant compound at 10 mg/kg BID; (2) oral administration of the instant compound at 25 mg/kg BID; (3) oral administration of the vehicle BID; and (4) intravitreal administration of 5 μ L Lucentis® (10 mg/mL, positive control treatment) at 1, 3, and 7 days following laser treatment.

12. I understand that fourteen days following laser application, the rats and mice were sacrificed to measure the extent of CNV at the Bruch's membrane rupture sites. The eyes of the animals were removed, and choroid-sclera-retinal pigment epithelium flat-mounts were prepared by removing the cornea and lens in 10% phosphate-buffered formalin. After dissecting the retina from the eyecup and discarding it, radial cuts were made in all four quadrants in order to flatten the remaining tissue. The flattened choroid-sclera-retinal pigment epithelium tissue was then mounted in Gel Mount (Biomedica; Victoria, Australia). Choroidal neovascular growth was assessed at two weeks post-laser treatment in

fluorescently-stained flat-mounts, using published methods. *See, e.g., Bora et al., J. Immunol.* 2005, 174(1):491-7. Endothelial cells were identified using FITC-conjugated Griffonia simplicifolia isolectin B₄ (Sigma-Aldrich, Inc.), and the elastin of the surrounding extracellular matrix was stained using donkey anti-elastin antibody conjugated to Cy3 (Santa Cruz Biotech., Inc.). Areas of abnormal vascular growth were measured via computer-assisted image analysis using high-resolution digital images of the stained choroid-sclera-retinal pigment epithelium flat-mounts. The effects of the various treatments on the progression of laser-induced CNV were determined using an analysis of variance (ANOVA) and the Dunnett's post-hoc test with significance set to $P < 0.05$. The sizes of the four lesions were averaged for each eye, the two eyes were averaged for each animal, and the values derived from each animal were averaged for each treatment group. The treatment group averages were used for the final analysis.

B. Results

13. I understand that with regard to the tests on mice, oral administration of the instant compound resulted in significant inhibition of laser-induced CNV. Specifically, administration of the instant compound at 5 mg/kg BID resulted in a 69% reduction in the neovascular area, and the administration at 15 mg/kg resulted in a 73% reduction in the neovascular area ($P < 0.002$). Moreover, the observed inhibition resulting from the administration of the instant compound was remarkably higher than the inhibition resulting from the intravitreal injection of Lucentis[®], which was 36% ($P = 0.0913$ under Dunnett's Method; $P = 0.0423$ under Student's t-test). *See Exhibit B, Figure 1.*

14. I understand that with regard to the tests on rats, oral administration of the instant compound resulted in significant inhibition of laser-induced CNV. Specifically, administration of the instant compound at 10 mg/kg BID resulted in a 61% reduction in the neovascular area, and administration at 25 mg/kg BID resulted in a 65% reduction in the neovascular area ($P < 0.0001$). Moreover, the observed inhibition resulting from the administration of the instant compound was comparable to the inhibition resulting from the intravitreal injection of Lucentis[®], which was 62% ($P < 0.0001$). *See Exhibit B Figure 2.*

III. Conclusion

15. It is my opinion that the observed efficacy of the instant compound in rat and mice tests is significant and surprising. Specifically, it is significant and surprising that oral administration of the instant compound performed as well as or better than the intravitreal injection of Lucentis®, which represents the current standard of clinical care in connection with the treatment of wet age-related macular degeneration.

16. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like may be punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of any patent issuing from the present application.

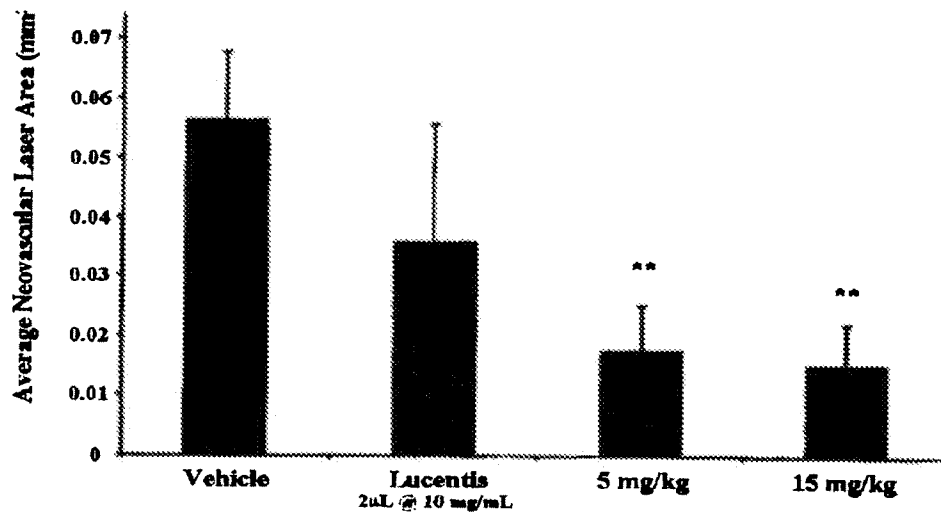
Dated: 5 August 2008

Peter H. Schaffer
PETER H. SCHAFER, Ph.D.

EXHIBIT B

Figure 1

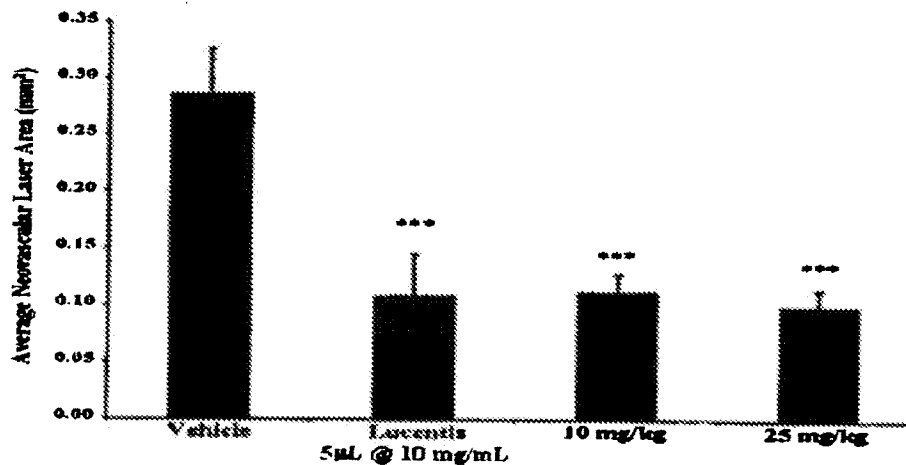
Histogram of Instant Compound on Laser-Induced Choroidal Neovascularization Areas in Mice



Asterisks (**) represent significance levels of $P < 0.002$ vs. vehicle control.

Figure 2

Histogram of Instant Compound on Laser-Induced Choroidal Neovascularization Areas in Rats



Asterisks (***) represent significance levels of $P < 0.0001$ vs. vehicle control.

Exhibit A

Curriculum Vitae

PETER H. SCHAFFER

126 John E. Busch Avenue
Somerset, NJ 08873
Phone: (732) 448-1222
Email: pschafer11@comcast.net

BIOGRAPHICAL INFORMATION

Nationality: United States Citizen
Place of Birth: Chicago, IL

EDUCATION

Doctor of Philosophy (December 1996)
Department of Biochemistry, Molecular Biology, and Cell Biology
Northwestern University, Evanston, IL

Bachelor of Science (June 1991)
Biological Chemistry, University of Chicago, Chicago, IL

PROFESSIONAL EXPERIENCE & RESEARCH TRAINING

Director of Biology, Department of Drug Discovery (Nov. 2006-present)
Associate Director of Biology, Department of Drug Discovery (Sept. 2003-Nov. 2006)
Group Leader (Oct. 2001-Sept. 2003)
Senior Research Scientist (Jan 2001-Oct. 2001)
Research Scientist (Apr. 1999-Jan 2001)
Immunotherapeutics, Drug Discovery
Celgene Corporation, Warren, NJ, and Summit, NJ
Research: Project Leader for SelCIDsTM (Selective Cytokine Inhibitory Drugs, PDE4 Inhibitors); Mechanism of action studies on thalidomide and IMiDsTM (Immunomodulatory Drugs).

Postdoctoral Research Associate (John J. Siskierka, Ph.D.; Nov. 1996-Apr. 1999)
Immunosuppression Team, Drug Discovery Research, The R. W. Johnson
Pharmaceutical Research Institute, Raritan, NJ
Research: p38 mitogen-activated protein kinase in CD28-mediated signaling and IL-4 production in T cells

08/05/08

Graduate Research Assistant (Susan K. Pierce, Ph.D.; June 1992-Nov. 1996)
Department of Biochemistry, Molecular Biology, and Cell Biology, Northwestern
University, Evanston, IL
Dissertation: The assembly, structure and regulation of function of MHC class II-
antigenic peptide complexes

Research Assistant (Donald A. Rowley, M.D., Ph.D.; 1989-1991)
Committee on Immunology, Department of Pathology, University of Chicago, IL
Research: Transforming growth factor- β and tumor escape from immunosurveillance

PROFESSIONAL MEMBERSHIPS

International Society for the Biological Treatment of Cancer
American Association for the Advancement of Science
American Association of Immunologists
Reviewer, Journal of Pharmacology and Experimental Therapeutics
Reviewer, European Journal of Hematology
Reviewer, Leukemia and Lymphoma
Reviewer, Life Sciences

AWARDS

Thomas Alva Edison Patent award, from R&D Council of NJ, for *US6962940 B2*, (+)-2-[1-(3-ethoxy-4-methoxyphenyl)-2-methylsulfonylethyl]-4-acetylaminoisoindoline-1,3-dione:Methods of using and compositions thereof. November 7, 2007.
Revlimid® sNDA Multiple Myeloma Merit Award, June 29, 2006.
Thalomid® sNDA Multiple Myeloma Merit Award, May 25, 2006.
Revlimid® Contributor Functional Legacy Award, February 28, 2006.
National Research Service Award, Cell and Molecular Biology Training Grant, US
Department of Health and Human Services, Public Health Service, September 1, 1993-
August 31 1995.

BIBLIOGRAPHICAL INFORMATION

Original Reports

Blansfield J.A., Caragacianu D., Alexander H.R. 3rd, Tangrea M.A., Morita S.Y.,
Lorang D., Schafer P., Muller G., Stirling D., Royal R.E., Libutti S.K. (2008)
Combining agents that target the tumor microenvironment improves the efficacy of
anticancer therapy. *Clin Cancer Res.* 14(1):270-80.

Mangiameli D.P., Blansfield J.A., Kachala S., Lorang D., Schafer P.H., Muller G.W.,
Stirling D.I., Libutti S.K. (2007). Combination therapy targeting the tumor
microenvironment is effective in a model of human ocular melanoma. *J Transl Med.*
5:38.

08/05/08

- Verhelle, D., Corral, L.G., Wong, K., Mueller, J.H., Moutouh-de Parseval, L., Jensen-Pergakes, K., Schafer, P.H., Chen, R., Glezer, E., Ferguson, G.D., Lopez-Girona, A., Muller, G., Brady, H.A. and Chan, K.W.H. (2007). Lenalidomide and CC-4047 inhibit the proliferation of malignant B cells while expanding normal CD34+ progenitor cells: New insights on the combination therapy with certain HDAC inhibitors for hematological cancers. *Cancer Research*, 67(2):746-55.
- Gandhi, A.K., Kang, J., Naziruddin, S., Parton, A., Schafer, P. H., and Stirling, D.I. (2006). Lenalidomide inhibits proliferation of Namalwa CSN.70 cells and interferes with Gab1 phosphorylation and adaptor protein complex assembly. *Leukemia Research*, 30(7):849-58.
- Kiaei, M., Petri, S., Kipiani, K., Gardian, G., Choi, D.-K., Chen, J., Calingasan, N. Y., Schafer, P., Muller, G.W., Stewart, C., Hensley, K., and Beal, M.F. (2006). Thalidomide and Lenalidomide Extend Survival in a Transgenic Mouse Model of Amyotrophic Lateral Sclerosis. *The Journal of Neuroscience*, 26(10): 2467-73
- Zhang, L.H., Wu, L., Raymon, H.K., Chen, R.S., Corra, L., Shirley, M.A., Narla, R.K., Gamez, J., Muller, G.W., Stirling, D.I., Bartlett, J.B., Schafer, P.H., and Payvandi, F. (2006). The synthetic compound CC-5079 is a potent inhibitor of tubulin polymerization and tumor necrosis factor-alpha production with antitumor activity. *Cancer Res*;66(2):951-9.
- Payvandi, F., Wu, L., Naziruddin, S.D., Haley, M., Parton, A., Schafer, P.H., Chen, R.S., Muller, G.W., Hughes, C.C., Stirling, D.I. (2005) Immunomodulatory drugs (IMiDs) increase the production of IL-2 from stimulated T cells by increasing PKC-theta activation and enhancing the DNA-binding activity of AP-1 but not NF-kappaB, OCT-1, or NF-AT. *J Interferon Cytokine Res*. 10:604-16.
- Zhou, S., Li, Y., Kestel, P., Schafer, P., Chan, E., and Paxton, J.W. (2005). Transport of thalidomide by the human intestinal Caco-2 monolayers. *European Journal of Drug Metabolism & Pharmacokinetics* ; 30(1-2): 49-61.
- Dredge, K., Horsfall, R., Robinson, S.P., Zhang, L.H., Lu, L., Tang, Y., Shirley, M.A., Muller, G., Schafer, P., Stirling, D., Dalgleish, A.G., Bartlett, J.B. (2005). Orally administered lenalidomide (CC-5013) is anti-angiogenic in vivo and inhibits endothelial cell migration and Akt phosphorylation in vitro. *Microvasc Res*. 69(1-2):56-63.
- Payvandi, F., Wu, L., Haley, M., Schafer, P.H., Zhang, L.H., Chen, R.S., Muller, G.W., Stirling, D.I. (2004). Immunomodulatory drugs inhibit expression of cyclooxygenase-2 from TNF-alpha, IL-1beta, and LPS-stimulated human PBMC in a partially IL-10-dependent manner. *Cell Immunol*. 230(2):81-8.
- Schafer, P.H., Gandhi, A.K., Loveland, M.A., Chen, R.S., Man, H.-W., Schnetkamp, P.P.M., Wolbring, G., Govinda, S., Corral, L.G., Payvandi, F., Muller, G.W., and

- Stirling, D.I. (2003). Enhancement of T Cell Cytokine Production and AP-1 Transcriptional Activity in T Cells by Thalidomide-Related Immunomodulatory Drugs. *J Pharmacol Exp Ther.* 305(3):1222-32.
- Marriott, J.B., Clarke, I.A., Czajka, A., Childs, K., Dredge, K., Man, H.-W., Schafer, P., Govinda, S., Muller, G.W., Stirling, D.I., and Dalglish, A.G. (2003). A Novel Subclass of Thalidomide Analogue with Anti-Solid-Tumor Activity in which Caspase Dependent Apoptosis is Associated with Altered Expression of bcl-2 Family Proteins. *Cancer Research* 63:593-9.
- Thurmond, R.L., Wadsworth, S.A., Schafer, P.H., Zivin, R.A., and Siekierka, J.J. (2001). Kinetics of Small Molecule Inhibitor Binding to p38 Kinase. *European Journal of Biochemistry* 268: 5747-54.
- Wadsworth, S. A., Cavender, D.E., Beers, S.A., Lalan, P., Schafer, P.H., Malloy, E.A., Wu, W., Fahmy, B., Olini, G.C., Davis, J.E., Pellegrino-Gensey, J.L., Wachter, M.P., Siekierka, J.J. (1999). RWJ 67657, a Potent, Orally Active Inhibitor of p38 MAP Kinase. *Journal of Pharmacology and Experimental Therapeutics* 291:680-7.
- Schafer, P.H., Wadsworth, S.A., Wang, L., and Siekierka, J.J. (1999). p38 α Mitogen-Activated Protein Kinase is Activated by CD28-Mediated Signaling and is Required for IL-4 Production by Human CD4⁺CD45RO⁺ T Cells and Th2 Effector Cells. *Journal of Immunology* 162: 7110-7119.
- Schafer, P.H., Wang, L., Wadsworth, S.A., Davis, J.E., and Siekierka, J.J. (1999). T Cell Activation Signals Upregulate p38 MAP kinase Activity and Induce TNF- α production in a Manner Distinct from LPS Activation of Monocytes. *Journal of Immunology* 162:659-668.
- Kanakaraj, P., Schafer, P.H., Cavender, D., Wu, Y., Ngo, K., Grealish, P., Wadsworth, S.A., Peterson, P.A., Siekierka, J.J., Harris, C.A., and Fung-Leung, W.-P. (1998). Interleukin (IL)-1 Receptor-associated kinase (IRAK) Requirement for Optimal Induction of Multiple Signaling Pathways and IL-6 Production. *Journal of Experimental Medicine* 187:2073-2079.
- Henry, J.R., Rupert, K.C., Dodd, J.H., Wadsworth, S.A., Cavender, D.E., Schafer, P.H., and Siekierka, J.J. (1998). 6-Amino-2-(4-fluorophenyl)-4-methoxy-3-(4-pyridyl)-1H-pyrrolo[2,3-b] pyridine (RWJ 68354): A Potent and Selective p38 Inhibitor. *Journal of Medicinal Chemistry* 41:4196-4198.
- Henry, J.R., Rupert, K.C., Dodd, J.H., Turchi, I.J., Wadsworth, S.A., Cavender, D.E., Schafer, P.H., and Siekierka, J.J. (1998). Potent Inhibitors of the MAP Kinase p38. *Bioorganic and Medicinal Chemistry Letters* 8:3335-3340.

Schafer, P.H., Malapati, S., Hanfelt, K.K., and Pierce, S.K. (1998). The Assembly and Stability of MHC Class II-($\alpha\beta$)₂ Superdimers. *Journal of Immunology* 161:2307-2316.

Schafer, P.H., Green, J.M., Malapati, S., Gu, L., and Pierce, S.K. (1996). HLA-DM is Present in One-Fifth the Amount of HLA-DR in the Class II Peptide Loading Compartment Where it Associates with Leupeptin-Induced Peptide (LIP)-HLA-DR Complexes. *Journal of Immunology* 157:5487-5495.

Schafer, P.H., and Pierce, S.K. (1994). Evidence for Dimers of MHC Class II Molecules in B Lymphocytes and Their Role in Low Affinity T Cell Responses. *Immunity* 1:699-707.

Cristau, B., Schafer, P.H., and Pierce, S.K. (1994). Heat Shock Enhances Antigen Processing and Accelerates the Formation of Compact Class II $\alpha\beta$ Dimers. *Journal of Immunology* 152: 1546-1556.

Shah, S.A., Schafer, P.H., Recchia, P.A., Polach, K.J., and LeMaster, D.M. (1994). Enantiomeric Conversion of Racemic Amino Acid Mixtures via an Oxidase-Aminotransferase Coupled System. *Tetrahedron Letters* 35: 29-32.

Chanatry, J.A., Schafer, P.H., Kim, M.S., and LeMaster, D.M. (1993). Synthesis of α,β -Deuterated ¹⁵N Amino Acids Using a Coupled Glutamate Dehydrogenase-Branched-Chain Amino Acid Aminotransferase System. *Analytical Biochemistry* 213: 147-151.

Reviews & Chapters

Houslay, M.D., Schafer, P.H. and Zhang, K.Y.J. (2005) Phosphodiesterase-4 as a therapeutic target. *Drug Discovery Today* 10(22):1503-19. [this review was top cited article in DDT in 2007].

Schafer, P.H. (2005, manuscript submitted) Progress in the Development of Phosphodiesterase Inhibitors for Vascular, Respiratory, and Neurological Disorders. *Current Opinion in Investigational Drugs*.

Zeldis, J.B., Schafer, P.H., Bennett, B.L., Mercurio, F., and Stirling, D.I (2003). Potential new therapeutics for Waldenstrom's macroglobulinemia. *Semin Oncol.* Apr; 30 (2):275-81.

Schafer, P.H., and Pierce, S. K. (1997). Antigen Processing and Presentation. In: Comprehensive Toxicology Vol. 5, pp. 215-233, Elsevier Science, Oxford. Sipes, I.G., Gandolfi, A.J., and McQueen, C.A., eds.

Schafer, P.H., Pierce, S.K., and Jardetzky, T.S. (1995). The Structure of MHC Class II: Role for the Dimer of Dimers. *Seminars in Immunology*, 7:389-398.

Pierce, S.K., Green, J.M., Faassen, A.E., Xu, X., Song, W., Cho, H., Schafer, P., Psaradellis, T., Wagle, N., and Kim, J. (1995). The Intracellular Assembly of Antigenic-Peptide-Class II Complexes. *Biomedical Peptides, Proteins, and Nucleic Acids*, 1:149-156.

Pierce, S.K., Faassen, A.E., Qiu, Y., Xu, X., Schafer, P., and Dalke, D. (1994). Regulation of Antigen Processing and Presentation in B Lymphocytes. In: Antigen Processing and Presentation, pp. 143-156, Academic Press, San Diego. Humphreys, R.E. and Pierce, S.K., eds.

Patents

Schafer P.H. et al. . Methods of using 1-oxo-2-92,6-dioxopiperidin-3-yl)-4-methylisoindoline. US patent application 61/070,512 filed march 24, 2008.

Zeldis, J., Rohane, P., and Schafer P.H. Methods for treating cutaneous lupus using amino isoindoline compounds. US patent application serial nos. 60/754,795 filed December 29, 2005; 60/755,246 filed December 29, 2005; 60/787,436 filed March 30, 2006.

Muller, G.W., Scxhafer, P.H., and Rohane, P. Methods of the treatment or prevention of exercise-induced asthma using (+)-2-[1-(3-ethoxy-4-methoxyphenyl)-2-methylsulfonyl-ethyl]-4-acetylaminisoindoline-1,3-dione. Non-provisional patent application 60/366,515 filed March 20, 2002.

Zeldis, J., Rohane, P., and Schafer, P. Methods of using and compositions comprising PDE4 modulators for treatment, prevention, and management of airway inflammation. Provisional use patent application 60/634,982, filed December 13, 2004.

Muller, G.W., Schafer, P.H., Man, H.-W., and Ge, C. (2005). (+)-2-[1-(3-ethoxy-4-methoxyphenyl)-2-methylsulfonylethyl]-4-acetylaminoisoindoline-1,3-dione:Methods of using and compositions thereof. *US6962940 B2*.

Schafer, P.H., Muller, G.W., Man, H.-W., and Ge, C. (2003). (+)-2-[1-(3-ethoxy-4-methoxyphenyl)-2-methylsulfonylethyl]-4-acetylaminoisoindoline-1,3-dione:Methods of using and compositions thereof. *WO 03/080049 A1*.

Selected Abstracts

Schafer P., Rohane P., Adams M., Bartlett, J.B., Capone L., Gandhi A.K., Hu A., Wu L., Jones M., Loveland M. A., Man H.-W., Parton A., Sutherland D., Muller G.W., Zeldis J., and Stirling D.I. PDE4 Inhibitor Apremilast in the Treatment of Psoriasis. *Gordon Research Conference on Cyclic Nucleotide Phosphodiesterases*, Lucca, Italy, June 8-13, 2008.

Zhang L.H., Schafer P., Muller G., Stirling D., and Bartlett B. The ratio of cyclin D1/p21kip baseline gene expression and SPARC gene expression can be potential predictors of non-Hodgkin's lymphoma (NHL) patient response to lenalidomide therapy. *American Society of Clinical Oncology Annual Meeting*, Chicago, IL, May 30 – June 3, 2008.

Wu L., Adams M., Schafer P., Muller G., Stirling D., Bartlett, J.B. Lenalidomide enhancement of NK cell-mediated antibody-dependent cellular cytotoxicity (ADCC) is mediated by granzyme B and FasL and is associated with modification of SHIP-1, PLC-g2 and pERK and enhanced chemokine production. *American Society of Hematology Annual Meeting and Exposition*, Atlanta, GA, December 8-11, 2007.

Gandhi A., Kang J., Stirling D., and Schafer P. Inhibition of cell proliferation by lenalidomide is associated with stimulation of EGR1 transcriptional activity in a chromosome 5 deleted Burkitt's lymphoma and multiple myeloma cell line. *European Hematology Association 12th Congress*, Vienna Austria June 7-10, 2007.

Bartlett J.B., Wu L., Adams M., Schafer P., Muller G., Stirling D. Lenalidomide and pomalidomide strongly enhance tumor cell killing in vitro during antibody-dependent cellular cytotoxicity (ADCC) mediated by trastuzumab, cetuximab and rituximab. *American Society of Clinical Oncology 43rd Annual Meeting*, Chicago, IL June 1-5, 2007.

Zhang, L.H., Lu, L., Wu, L., Dredge, K., Bartlett, J. B., Schafer, P., Muller, G., Dalglish, A., Stirling, D. Comparison of Anti-Angiogenic Activities of Thalidomide and Lenalidomide in vitro. *AACR Annual Meeting*, Washington, DC, April 1-5, 2006.

Gandhi A., Kang J., Capon, L., Schafer P., Sherman W., Stirling D. Combination therapy effects of lenalidomide in FGFR3 multiple myeloma cell lines. *European Hematology Association 11th Congress*, Amsterdam, The Netherlands, June 15-18, 2006.

Gandhi, A.K., Schafer, P. H., Naziruddin, S., Parton, A., Verhelle, D., Brady, H., and Stirling, D.I. Lenalidomide Inhibits Proliferation of Chromosome 5 Mutant Hematopoietic Tumor Cells and Interferes with Adaptor Protein Complex Assembly and Phosphorylation. *International MDS Symposium*, Nagasaki, Japan, May 2005.

Bartlett, J.B., Dredge, K., Zhang, L. H., Horsfall, R. J., Robinson, S.P., Lu, L., Muller, G.W., Schafer, P., Dalglish, A.G., Payvandi, F., and Stirling, D.I. Orally administered Lenalidomide (CC-5013) is anti-angiogenic in vivo and inhibits endothelial cell migration, cadherin 5/CD31 interaction and Akt phosphorylation in vitro. *European Hematology Association Meeting*, Stockholm, Sweden, May 2005.

Zhang, L.-H., Lu, L., Wu, L. Schafer, P.H., Chen, R.S., Muller, G.W., Stirling, D.I., Payvandi, P. CC-5079, a novel microtubule and TNF- α inhibitor with antiangiogenic and antimetastatic activity. *AACR-NCI-EORTC International Conference: Molecular Targets and Cancer Therapeutics*, Boston, MA, November 2003.

Schafer, P.H., Man, H.-W., Loveland, M., Govinda, S., Corral, L.G., Muller, G.W., and Stirling, D.I. CC-10004: A Novel PDE4 Inhibitor with an Improved Therapeutic Index in a Lung Neutrophilia Model. *New Drugs for Respiratory Diseases V*, San Diego, CA, July 2002.

Schafer, P.H., Payvandi, F., Loveland, M., Corral, L., Chen, R., Man, H.-W., Muller, G., and Stirling, D.I. Immunomodulatory Drugs (IMiDsTM) Enhance T Cell IL-2 Production by Augmenting AP-1 and NF- κ B Activity. *Immunology 2000*, Seattle, WA, May 2000.

Schafer, P.H., Wadsworth, S.A., Wang, L., and Sierkierka, J.J. p38 MAP Kinase in CD4⁺ T Cells: Activation vis CD28 Signaling Alone and Preferential Role in IL-4 Production. *Keystone Symposium on T Lymphocyte Activation, Differentiation, and Death*, Keystone, CO, January 1998.

Schafer, P.H., and Pierce, S.K. Biochemical Characterization of MHC Class II Superdimers. *Keystone Symposium on Lymphocyte Activation*, Hilton Head, SC, March 1996.

Schafer, P.H., and Pierce, S.K. Heat Shock Enhances Antigen Processing in Mouse Peritoneal Macrophages. *The 9th International Congress of Immunology*, San Francisco, CA, July 1995.

Moderator

Session Chair, Angiogenesis Research and Therapeutics, GTC Bio, San Diego, CA, March 9-10, 2006.

Presentations

Immunomodulatory Activity of Lenalidomide; Implications for the Treatment of Hematological Malignancies. *Molecular Therapeutics of Cancer Research Conference*, Princeton, NJ, Aug. 10-13, 2008.

Novel Approach to Inflammatory and Neuropathic Pain, *SMi Group 8th Annual Pain Therapeutics Conference*, London, UK, June 11-12, 2007.

Understanding the mechanism of action of immunomodulatory agents in haematological malignancy, *47th Annual Scientific Meeting of the British Society for Haematology*, Bournemouth, UK, May 1, 2007.

Advancing Treatment for Malignant Conditions: The Celgene Pipeline. (Pipelines in Oncology Series) Dana Farber Cancer Institute, Boston, MA. January 18, 2007

CC-10004: Effects of an Orally Available Inhibitor of TNF- α and Other Inflammatory Mediators in Psoriasis, *Inflammation & Immune Diseases Drug Discovery & Development Summit, Strategic Research Institute*, New Brunswick, NJ, March 20-21, 2006.

Anti-angiogenic activity of lenalidomide (Revlimid®) and its clinical application in del 5q MDS, *Angiogenesis Research and Therapeutics, GTC Bio*, San Diego, CA, March 9-10, 2006.

Development of Revlimid® as an Immunomodulatory and Anti-Angiogenic Agent, *SRI 7th Annual Anti-Cancer Drug Discovery & Development Summit*, Boston, MA, July 12, 2005.

Maximizing Efficacy of Phosphodiesterase 4 Inhibitors for COPD and Asthma: Therapeutic Index of CC-10004, *SMi Asthma and COPD Conference*, London, UK, April 28, 2005

Revlimid as a Multi-Functional Anti-Angiogenic Agent for Myeloma and Other Conditions, *Strategic Research Institute 2nd Annual Angiogenesis New Opportunities & Solutions for Drug Development*, Cambridge, MA, September 28, 2004.

Widening the Therapeutic Window with CC-10004, a Novel PDE4 Inhibitor, *SRI Conference on Phosphodiesterases in Disease*, Princeton, NJ, November 2003.

Small Molecule Therapeutic Approaches to Asthma and Other Respiratory Diseases, *SMi Conference on Asthma Therapeutics*, London, UK, April 2003.

Novel Inhibitors of TNF- α Overproduction, *SMi Conference on Anti-Arthritic Agents*, London, UK, April 2003.

CC-10004: A Novel PDE4 Inhibitor with an Improved Therapeutic Index in a Lung Neutrophilia Model, *SRI Inflammation in Drug Discovery and Development VII*, San Diego, CA, February 2003.

PDE4 Inhibitors, *New Drugs for Respiratory Diseases V*, Coronado, CA, July 3-5, 2002.

CC-10004: A Novel PDE4 Inhibitor with an Improved Therapeutic Index in a Lung Neutrophilia Model, *Gordon Research Conference on Cyclic Nucleotide Phosphodiesterases*, South Hadley, MA, June 2002.

Anti-Cancer Activities of Thalidomide Analogs, *University of Texas M.D. Anderson Cancer Center Department of BioImmunotherapy Seminar Series*, Houston, TX, April 2002.

SelCIDs/IMiDs: Potential Anti-Arthritic Agents, *Advances in Anti-Arthritic Agents SMi Conference*, London, UK, April 2002.

Thalidomide Analogs as Suppressors of Inflammation, *The Inflammation Research Association West Coast Symposium*, La Jolla, CA, March 2001.

Fundamentals of the HLA System, *American Society for Histocompatibility and Immunogenetics 23rd Annual Meeting*, Atlanta, GA, October 1997.

Review of MHC Biosynthesis and Antigen Processing, *American Society for Histocompatibility and Immunogenetics 22nd Annual Meeting*, San Diego, CA, October 1996.